

THURSDAY, MARCH 7, 1889.

TOLLENS'S "CARBOHYDRATES."

Kurzes Handbuch der Kohlenhydrate. By B. Tollens. (Breslau: Maruschke and Berendt, 1888.)

THIS admirable *précis* of the chemistry of the carbohydrates is a model work of its kind. It is not merely a lucid account of this well-marked group of carbon compounds, but has the rare merit of preserving its facts and conclusions in their original guise—that is, as the offspring of research. Too often, the authors of treatises on experimental science, more especially of the genus text-book, are compelled to present their subject in such a way as to produce the impression that phenomena follow from laws, rather than that laws have followed from the phenomena which they generalize. This is no doubt justifiable, and in the end perhaps not seriously harmful, since the student is soon brought by his laboratory work to an appreciation of the perspective of his science, and to the correction of any superstitions which may have been engendered in his mind as to its origin and up-building. In the book before us, on the other hand, every fact is stamped and recorded as the contribution of a worker. A specialist, such as the author, engaged in active research in the field which he pauses, as it were, to describe, must write from the point of view of the worker; and hence it is that in the 330 short pages into which his account is condensed, we have over 1300 references to original memoirs. The impression produced, moreover, is that he has submitted this huge mass of experimental evidence to a searching examination, of which the matter of the book is the valid survival. It is to be hoped that the author's example will be generally followed. It is becoming less and less possible to keep pace with research in the many special branches into which chemistry is diverging. But if specialists will, as the author has done, unburden themselves to an imaginary interviewer, the task, which is laid upon us all, of keeping up with the progress of discovery and research will be both sweetened and lightened.

In proceeding to notice more particularly the contents of the work, we are struck, first, with its method of classification. The treatise is divided into two parts, the first dealing with the carbohydrates proper, together with such other comparatively inert compounds, *e.g.* arabinose, as stand in close connection with them; the second is an account of the derivative acids and their lactones ("saccharines").

The first section sets forth the general or typical properties and characteristics of the group, with an account of their origin in the plant, the evidence as to their molecular weight and constitution, their synthetical formation in the laboratory (phenose, acrose), their isolation in the pure state, their optical properties, and the various methods adopted for the determination of specific rotation. Then follows in outline the scheme of classification. The various groups under which the compounds are ranged are: (1) monosaccharides, or glucoses, $C_6H_{10}O_5$ (dextrose, lævulose, &c.); (2) disaccharides, or saccharoses, $C_{12}H_{22}O_{11}$ (cane-sugar, maltose,

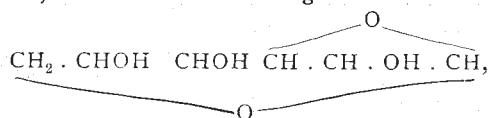
&c.); (3) polysaccharides—(a) crystalline (raffinose, $C_{36}H_{64}O_{32} \cdot 10H_2O$, and lactosin, $C_{36}H_{62}O_{31}$); (b) non-crystalline or *saccharocolloids*, &c., $C_6H_{10}O_5 \pm MH_2O$ (starch, inulin, gums, celluloses, pectone substances); (4) the somewhat miscellaneous group of substances which, although lacking some one or more of the group characteristics, are yet closely related to the carbohydrates—(a) in which $H : O = 2 : 1$ (arabinose, cerasinose, inosite, formose); (b) in which $H : O > 2 : 1$ (quercite, pinite, mannite).

Having thus forecast the order of treatment, the author plunges at once into the work of particular description. Beginning with dextrose, we have at the outset (a) a terse but minute account of the laboratory method of isolation from saccharose, also of the method of manufacture from starch; (b) certain physical properties of the anhydride and monohydrate, with solubilities and a table of specific gravities of aqueous solutions; (c) behaviour towards polarized light,—after a brief discussion of the variations between the numbers of different observers and their cause, we have the author's final selection of the formulæ, (1) for the anhydride ($\alpha_0 = 52.5 + 0.018796 P + 0.00051683 P_2$, and (2) for the monohydrate ($\alpha_0 = 47.73 + 0.015534 P + 0.0003883 P_2$, P being the percentage of substance in solution; (d) the results of heating at various temperatures; (e) actions of acids; (f) actions of alkalies; (g) action of nascent hydrogen (conversion into mannite); (h) action of the halogens and various forms of oxygen; (i) action of oxidizing (metallic) oxides; and (k) its several fermentations. Then follows a detailed account of the derivative compounds of dextrose: (A) with bases; (B) with negative radicles; (C) ethereal compounds; (D) hydrazine derivatives; (E) compounds with aromatic amines; (F) with metallic salts; (G) with hydrocyanic acid (conversion into normal heptoic acid). The author then gives a detailed account of analytical methods, *i.e.* (i.) identification by qualitative reaction; (ii.) estimation by polarization of the various oxidation methods (Cu, Hg, and Ag salts), and by fermentation. We have reproduced these heads, under which the chemistry of dextrose is treated, as characteristic of the method of the book. The typical saccharose, cane-sugar, is dealt with in even greater detail, the author giving a complete though brief account of the process of preparation from beet, with illustrated descriptions of the manufacturing plant, as also of the polarization instruments commonly employed for sugar estimation, *viz.* the Soleil-Ventzke-Scheibler, and that of Schmidt and Häusch.

Of the amorphous polysaccharides or saccharocolloids, starch is treated at considerable length. The views of physiologists as to its origin in the plant are briefly discussed. Its resolutions by the various hydrolytic reagents are dealt with in detail, and due prominence is given to the results of the researches of O'Sullivan and of Brown and Heron. Special details are given of the methods of estimation of starch in farinaceous raw materials, with a description of the Lintner-Soxhlet apparatus for carrying out the acid hydrolysis. As the starch group is characterized by resolution into dextrose, so the inulin group, next described, appear to be poly-derivatives of lævulose. A third is composed of substances yielding galactose as a product of resolution (lævulan, galactan, Carragheen mucilage), while a fourth comprises such

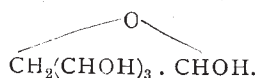
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gums and mucilages as yield various glucoses, and sometimes also arabinine, as products of hydrolytic resolution (gum-arabic, cerasin, bassorin, "wood gum"). Ascending in the scale of molecular complexity, the celluloses are next described; and lastly, in separate sub-sections, lignin, cork, and pectic derivatives. We have been interested in comparing the author's account of the latter group with those given under "Celluloses" in the new edition of Watts's "Dictionary." There is a close agreement in general method of treatment; and it is satisfactory to find that the problem of the constitution of the celluloses is being worked on such lines as would be laid down from a study of the general view of the carbohydrates which Prof. Tollens has given us. Neither of these accounts of cellulose suggests any probable constitutional formula for the unit group of which the celluloses may be regarded as poly-derivatives; but, putting the views of both authors together, we arrive at the following—

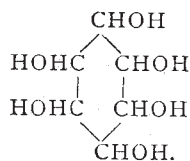


which we think will at least be found of service as a working hypothesis. In the section "Lignin," Prof. Tollens has overlooked some of the researches of recent years, which have, as the result of investigations of its hydrolysis and chlorination, more definitely identified the non-cellulose constituent of lignified tissue with a furfuralic constitution on the one side, and the tendency to an aromatic grouping on the other. In the section "Cork," he has also overlooked some of Fremy's interesting work on the constitution of "cuticular" substances. The concluding section of the saccharocolloids comprises the pectic group of plant constituents, which are briefly but fully described.

The fourth section opens with an account of *arabinose*, which the author represents by the constitutional formula—



Formose, or polymerized formaldehyde, is not regarded as a true glucose. Carius's *phenose* is described; the evidence as to its composition, however, is very slender. The writer has, moreover, devoted some time to a repetition of Carius's research, but failed to obtain any product such as that described. *Inosite* is represented on the basis of Maquenne's researches, by the symmetrical formula—



Dambonite and *bornesite*, which are found in caoutchouc-yielding juices, are described as the mono- and di-methyl ethers of inosite, respectively.

The fifth section comprises the hexahydric alcohol mannite and its isomerides, dulcitate, sorbite, and perseite, of which the typical mannite is fully described.

The second part of the work gives a detailed account of

"substances closely related to the carbohydrates, and obtained for the most part from them, which are either acids or acid-anhydrides (lactones), and the molecule of which contains 6 C-atoms": (a) saccharinic acid, $\text{C}_6\text{H}_{12}\text{O}_6$, and its isomerides, iso- and *meta*-saccharinic acids, their lactone-anhydrides, $\text{C}_6\text{H}_{10}\text{O}_5$, "*saccharines*," and their oxy-derivatives, *saccharones*, $\text{C}_6\text{H}_8\text{O}_6$; (b) gluconic acid, $\text{C}_6\text{H}_{12}\text{O}_7$, and its isomerides, galactonic and arabinose carbonic and mannitic acids; saccharic acid, $\text{C}_6\text{H}_{10}\text{O}_8$, and its isomerides, mucic, iso-, *meta*-, and *para*-saccharic acids, with their lactonic and other derivatives.

Such is a brief account of the contents of the book before us. The main purpose is necessarily the theoretical treatment of the subject—from the point of view, that is, of pure chemistry; at the same time due prominence is given to technical considerations, and the physiological aspects of the subject are by no means excluded.

We do not believe that we are yet within measurable distance of a knowledge of the actual molecular constitution of the carbohydrates. We do not even think that the evidence for the C_6 formulæ of the simplest members is at all conclusive. One of the assumed criteria of this point—the calculation of molecular weight from the lowering of the freezing-point of solvents by the presence of compounds in solution, as proposed by Raoult—is not mentioned by Prof. Tollens. At a recent meeting of the Chemical Society, Messrs. Brown and Morris communicated the results of an investigation of the freezing-point of solutions of the simpler carbohydrates, which appear to confirm the generally accepted views. Nevertheless, it would be premature to pronounce at all positively, either as to this particular criterion, or as to the evidence generally on these points.

The chemistry of the carbohydrates brings us into contact with the syntheses and transformations of the organic world. The plant is, and will remain through all time, the chemist's ideal. Every contribution to the chemistry of the carbohydrates is a step towards a comprehension of the chemistry of elaboration. The number of workers in the field is relatively small, but will increase as the methods of investigation are rendered more precise. It is from this point of view that we commend this little work to the notice of all who have either a special or general interest in plant-chemistry.

BRITISH MOSSES.

British Mosses. By F. E. Tripp. 2 Vols. New Edition. (London: George Bell and Sons, 1888.)

THE fact that a new edition of this work has been called for shows that these elegant plants have a wide-spread circle of admirers, and that there are many seekers after a knowledge of their structure.

The introduction occupies thirty-eight pages. In Sect. I, on the homes of mosses, we have a highly poetical description of the third day of Creation, and production of vegetation according to Genesis. This is followed by the natural distribution and habits of the mosses; and by charming word-pictures of woods and moorlands the authoress compels her readers to accompany her and see for themselves the beauties that await observation on every side and at every season.

Sect. 2, the characteristics of mosses, is written in